IN THE CLAIMS:

Cancel claims 24-26.

Substitute amended claim 28 for pending claim 28 as follows:

28. (Amended) The desalination process of claim 1, wherein the first stream of water is selected from the group consisting of salt water, seawater, brackish water and impaired water.

REMARKS

I. Claim Amendments

Claims 24-26 have been canceled. Applicant elects to address the rejections leveled against these claims in another application and, therefore, Applicant reserves the right to file a continuation application directed to the cancelled subject matter. The dependency of claim 28 has been amended in view of the cancellation of claim 24. No new matter has been introduced by any of the claim amendments.

Upon entry of the Amendment, claims 1-18 and 27-29 are pending. As such, all of the pending claims are either directly or indirectly dependent on claim 1.

II. Claim Rejections – 35 U.S.C. §112

Claims 24 and 26 are rejected under 35 U.S.C. §112, second paragraph, as allegedly being incomplete for omitting essential elements and as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

The rejection is moot in view of the cancellation of claims 24 and 26. Accordingly, withdrawal of the §112 rejection is requested.

III. Claim Rejections – 35 U.S.C. §102

Claim 24 is rejected under 35 U.S.C. §102(b) as allegedly being anticipated by US 3,725,267 to Gelblum ("Gelblum").

The rejection is moot in view of the cancellation of claim 24. Accordingly, withdrawal of the §102 rejection based on Gelblum is requested.

IV. Claim Rejections – 35 U.S.C. §103

Claims 1-8, 11-16, 24-26, 28 and 29 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Gelblum in combination with the publication by Wensley et al. "Ion Selective Membranes: A Presoftening Process For Seawater Distillation", Proceeding of the 7th International Symposium on Fresh Water from the Sea, Vol. 1, 417-426 (1980) ("Wensley").

Gelblum discloses a process for softening water by the addition of barium carbonate ($BaCO_3$) and small, catalytic amounts of CO_2 to sea water. The addition of $BaCO_3$ and CO_2 to sea water results in the *in situ* formation of barium bicarbonate ($Ba(HCO_3)_2$) which reacts with sulfate and calcium to form a precipitate consisting essentially of barium sulfate and calcium carbonate. The softened water can then be heated to precipitate out magnesium hydroxide. (See Abstract).

At column 1, lines 62-63, Gelblum notes that the $Ba(HCO_3)_2 \cdot CaSO_4$ reaction mechanism is suitable for softening seawater. At column 2, lines 2-15, Gelblum provides the equations by which the chemical reaction proceeds in seawater. As such, it is the intention, purpose and function of Gelblum to soften sea water by means of a chemical reaction requiring the addition of $BaCO_3$ and CO_2 to form a joint precipitate of $BaSO_4$ and $CaCO_3$.

Figure 1 of Gelblum is a drawing of the prior art process according to which a stream of sea water is processed in the reactor **1** by the $Ba(HCO_3)_2 \cdot CaSO_4$ reaction mechanism to produce a stream of softened water that is feed to a distillation system **3**. Gelblum provides, however, that no scale problems are provided when sea water feed is 60-70% decalcified. Figure 2 illustrates this modification whereby a stream of sea water is split into two streams: a first stream softened in reactor **1** by the $Ba(HCO_3)_2 \cdot CaSO_4$ reaction mechanism and a second stream which is not softened. The two streams are mixed to form a feed which is sent to the distillation system **3**. Gelblum states that the decalcification of sea water to the extent of 60-70% ***reduces the size of the plant and operating costs*** (col. 4, lines 33-34).

In summary, therefore, Figures 1 and 2 show that it is an express object of Gelblum to soften sea water by the $Ba(HCO_3)_2 \cdot CaSO_4$ reaction mechanism to form a joint precipitate of $BaSO_4$ and $CaCO_3$ (See claim 1). There is no disclosure or suggestion of achieving this object with the use of ion selective membranes. Moreover, there is no working example of the modification illustrated by Figure 2. As such, Gelblum's disclosure regarding the embodiment of Figure 2 is hypothetical and non-enabling.

The Examiner relies on the secondary reference to Wensley for the disclosure of a seawater pre-softening process which uses ion selective membranes. According to Wensley, sea water is passed through an ion selective membrane to form a first water product having a reduced content of ionic species. Thereafter, 100% of the softened water product is used as the make-up feed to a distillation plant. As such, there is no disclosure or suggestion of blending streams of variable concentration of hardness to form a blended feed to the distillation plant. Wensley further provides that removal of 60% of Ca^{2+} and SO_4^{2-} ions from the sea water feed would allow the distillation plant to be operated at higher temperatures and lower energy levels (page 420). *X*

Thus, the Examiner alleges that it would have been obvious at the time the claimed invention was made to modify the process of Gelblum, as illustrated by Figure 2, by using the ion selective membranes of Wensley to presoften a stream of water to be feed to a distillation plant. Applicant respectfully disagrees for the following reasons.

The presoftening process of Gelblum is a chemical process, i.e., the $Ba(HCO_3)_2 \cdot CaSO_4$ reaction mechanism, resulting in the formation and recovery of the chemically-precipitated $BaSO_4$ and $CaCO_3$ ions (See claim 1, step (c) and claim 14, step (d)). In contrast, Wensley uses ion selective membranes to pretreat water. Ion selective membranes operate by two principles: rejection of neutral particles according to size and rejection of ionic matter by electrostatic interaction with a charged membrane. As such, the pretreatment of water with ion selective membranes does not result in the binding, precipitation and recovery of one or more ionic species. Rather, the ion selective membrane acts to prevent the passage of large particles of ionic matter which may be recovered in the form of a concentrate, but not as a precipitate, on one side of the membrane.

Thus, the intended function of Gelblum and Wensley are technologically incompatible. The proposed modification of Gelblum with the ion selective membranes of Wensley would destroy the purpose and function of Gelblum. For example, Gelblum expressly provides that the modified process illustrated by Figure 2 ***"reduces the size of the plant and its operating costs"*** (col. 4, lines 33-34). The use by Gelblum of chemical additives ($BaCO_3$ and CO_2) to perform the softening process provides the means for controlling the size and operating costs of the plant. Clearly, the modification of Gelblum to include ion selective membranes would increase plant size and energy input. Even Wensley recognizes the ***"additional energy input for the membrane system"***. (Abstract). As such, the person of ordinary skill in the art who is interested

in water-softening processes by chemical precipitation would not be motivated to consider the use of ion selective membranes as disclosed by Wensley.

Therefore, Gelblum and Wensley are not properly combinable. The modification of Gelblum to include the ion selective membranes would destroy the intent, purpose and function of the method disclosed by Gelblum. It is respectfully submitted, therefore, that the rejection is based on an impermissible hindsight reconstruction of the invention. As such, the Examiner has not established a *prima facie* case of obviousness.

Furthermore, it would not be obvious, as alleged by the Examiner at page 4 of the Office Action, to arrive at the claimed invention by modifying the Gelblum system to operate with membranes having 60% efficiency, as suggested by Wensley, to prepare a feed with a 60% reduction of scale forming ions. Although Wensley discloses that the removal of 60% of the calcium and sulfate ions might possibly improve the operation of a desalination plant, Wensley nevertheless intends and requires that ***100%*** of a feed stream would be treated with an ion selective membrane having 60% efficiency. In any event, to achieve removal of 60% of the calcium with a membrane having 60% efficiency, Applicant submits that 100% of the feed would have to be treated. In contrast to Wensley, it is possible with the claimed invention to soften a significantly smaller percentage of the feed, e.g., 10-20%, and blend the softened stream with untreated water to achieve an advantageous improvement in operating conditions, e.g., increased top brine temperature (See Tables 8-11 at pp. 13-14).

Moreover, on page 420 in the same paragraph cited by the Examiner, Wensley discloses that "...if the operation of an MSF plant could be conducted at temperatures ***near 200°C***, the specific energy consumed could be reduced to 60 to 70% of that required for operation at 120°C". (Emphasis added). Applicant submits that no MSF plant is capable of operating at the

conditions suggested by Wensley. Specifically, a MSF system operating at the high temperatures suggested by Wensley is not feasible due to the material, very high pressures inside the MSF system and the aggressiveness of the flashing process which would be required to achieve the energy savings as postulated by Wesley. As such, the disclosure upon which the Examiner relies is hypothetical and unworkable.

In summary, therefore, the combination of Gelblum and Wensley is improper:

- Gelblum softens water by chemical precipitation; in contrast, Wensley is aimed at the prevention of precipitation and uses ion selective membranes to softened water. Therefore, Gelblum and Wensley represent diverse and technologically incompatible methods of softening water.
- The person of ordinary skill in the art who is interested in water-softening processes by chemical precipitation would not be motivated to consider the use of ion selective membranes as disclosed by Wensley.
- The incorporation of ion selective membranes in the Gelblum process defeats the express purpose and function of Gelblum , i.e., to reduce the size of the plant and its operating costs (col. 4, lines 33-34).
- To achieve removal of 60% of the calcium with a membrane having 60% efficiency, as suggested by Wensley, Applicant submits that 100% of the feed would have to be treated. Therefore, the combination of Gelblum with Wensley does not suggest the claimed invention wherein only a percentage of the feed is presoftened and blended with the untreated water to produce a variable feed.

For all of the foregoing reasons, withdrawal of the §103 rejection based on the combination of Gelblum and Wensley is requested.

V. Claim Rejections – 35 U.S.C. §103

Claims 1-3, 5, 8, 13-18,and 24-29 are rejected under 35 U.S.C. §103(a) as being unpatentable over US 6,113,797 to Al-Samadi ("Al-Samadi").

Al-Samadi is directed to a two-stage membrane process for purifying scale–containing water. Figure 1 illustrates the basic principles of the Al-Samadi process which are incorporated in the embodiments of Figures 2-8. Therefore, as shown in Figure 1, a stream of water containing hardness ions is pretreated and passed through a first stage membrane **7** which can be a reverse osmosis (RO) membrane or a nanofiltration (NF) membrane. The concentrate from the first stage membrane is sent to and passed through a second stage membrane **15** which is also a RO membrane or a NF membrane. The concentrate of the second stage membrane is then sent and passed through an ion exchange softening resin **17**. The resulting stream of softened water **12** is split into two streams, i.e., stream **9** and stream **10**, which are recycled and blended with hardness-containing streams feeding the first and second stage membranes (Fig. 1; col. 4, lines 15-39). The permeates from the first and second stage membranes are combined to provide a stream of purified water.

In the first instance, it is important to note that Al-Samadi does not teach or suggest the use of an ***ion selective membrane*** as claimed, e.g., a nanofiltration membrane (claims 1 and 8), to form a stream of softened water for blending with a second stream of water having a relatively higher concentration of hardness ions. Rather, to remove the scale-forming ions, Al-Samadi employs an ion exchange softening resin (See col. 4, lines 31-39, and col. 10, lines 32-36); a

dealkalization/carbon dioxide degassing device (See col. 10, lines 32-36); or chemical precipitation and filtration (See col. 5, lines 40-48). For the record, the disclosure of Al-Samadi indicates that ion exchange resins and ion selection membranes, such a reverse osmosis and nanofiltration membranes, are different. In this regard, the Examiner's attention is directed to Al-Samadi at column 1, lines 15-20 where the following disclosure appears:

> This water is frequently purified by using water softeners in the form of "***ion exchange resins***", chemical softeners using the cold lime or hot lime softening process, ***reverse osmosis and nanofiltration membranes*** and/or distillation. (Emphasis added)

Thus, according to Al-Samadi, ion exchange resins are not the same as the ion selection membranes, e.g., nanofiltration membranes, of the claimed invention. Moreover, as will be discussed further below, Al-Samadi teaches the uses of ion exchange resins, dealkalization/carbon dioxide degassing devices or chemical precipitation to remove scale forming ions. In contrast to Al-Samadi, the claimed invention uses ion selection membranes to treat and form a stream of softened water.

Specifically, in order to prevent formation of scale in the first and second membrane stages, Al-Samadi discloses that a suitable means such as an ion selection softening resin is used to treat the concentrate stream from the second stage membrane to provide a softened concentrate stream. The softened stream is then split into two streams: one stream is recycled and blended with the influent water stream feeding the first membrane stage and the second stream is recycled and blended with the concentrate from the first membrane stage to form the feed to the second membrane stage (col. 4, lines 31-39). Therefore, according to Al-Samadi, limitations on permeate recovery from an ion selective membrane, such as a reverse osmosis or nanofiltration membrane, are solved with the use of an ion exchange resins, a

dealkalization/carbon dioxide degassing device or chemical precipitation and filtration to remove hardness ions followed by splitting and recycling of the "softened" and "suspended solids free" second stage membrane concentrate.

Al-Samadi discloses that the high permeate recovery achievable in the first stage membrane system is made possible by recycling the "softened" and "suspended solids free" second stage membrane concentrate **9** from the second stage membrane system **11** since this recycle stream **9** will serve three main purposes: 1) it will reduce the overall hardness ion concentrations in the blended influent (stream **6**) to the first stage membrane system; 2) it will increase the solubility of all sparingly soluble salts in the blended influent stream **6** as a result of increasing the overall ionic strength of the solution; and 3) it reduces the water purification load on the high pressure second stage membrane system by treating a fraction of the "softened" concentrate at lower pressure in the first stage, hence the lower overall process capital and operating costs (col. 8, lines 32-46). Al-Samadi discloses that these three features allow attainment of much higher recoveries in the first stage at relatively low operating pressures, without scale formation on the membranes, thus improving the process economics significantly (col. 8, lines 46-50).

In view of these disclosures by Al-Samadi, Applicant respectfully submits that the softening process of Al-Samadi is achieved with an ion exchange resin, a dealkalization/carbon dioxide degassing device or chemical precipitation and filtration ***and not*** by an ion selective membranes such a reverse osmosis or nanofiltration membranes. Rather, the use of reverse osmosis and nanofiltration membranes by Al-Samadi for the first and second membrane stages is clearly a function of obtaining a suitable water product. In this regard, the Examiner's attention is directed to streams 14, 15 and 16 of figure 1.

Received from < 2128197583 > at 12/5/02 6:09:04 PM [Eastern Standard Time]

Furthermore, Applicant respectfully disagrees and submits that Al-Samadi does not disclose or suggest the claimed method step wherein the proportions of the softened water and untreated water are ***varied*** to increase the top operating temperature of the operating system and increase the recovery of potable water. This represents an unexpected improvement over the prior art. In this regard, the Examiner's attention is directed to Tables 7-11 of the specification where it is shown that optimal top operating temperatures and output of a multi-stage flash plant can be achieved by ***varying*** the percentage of the NF make-up. Specifically, as shown by Tables 8-11, it is possible to obtain a commercially viable TBT of 121°C with 10% NF make-up and a TBT of 125°C with 20% NF make-up. Figures 7-9 illustrate variable blends at a TBT of 120°C, 125°C and 130°C, respectively. Advantageously, therefore, the claimed invention provides a process wherein a variable portion of the feed is treated to optimize cost-efficiency and a reduction of the energy consumption of such plants without sacrificing yield or TBT. (See, page 2, lines 14-26).

Accordingly, Applicant submits that Al-Samadi is not aware of the effect which varying the percentage mix of softened water in a make-up feed has on the operating temperature of a distillation plant and the recovery of potable water. As such, this feature of the claimed invention and its concomitant advantages are not inherent, as alleged by the Examiner, in the Al-Samadi process.

Moreover, there is no suggestion by Al-Samadi that the order of the two membranes should be NF followed by RO as presently claimed. Rather, Al-Samadi discloses that the order of membranes is as follows: 1st stage membrane (RO or NF) followed by 2nd stage membrane (RO or NF). No guidance is offered by claim1 which is appears to be fatally indefinite and practically incomprehensible.

For all of the forgoing reasons, Applicant submits that the claimed invention is patentable over Al-Samadi:

- The claimed invention employs ion selective membranes, such as a nanofiltration membrane, to prepare a stream of softened water. In contrast, Al Samadi uses an ion exchange resin, a dealkalization/carbon dioxide degassing device or chemical precipitation and filtration. According to Al-Samadi ion exchange resins are not the same a ion selective membranes.
- The use of reverse osmosis or nanofiltration membranes by Al-Samadi is clearly a function of obtaining a suitable water product and not a function of removing hardness scale-forming ionic species which are removed by an ion exchange resin, a dealkalization/carbon dioxide degassing device or chemical precipitation and filtration.
- Al-Samadi does not disclose or suggest the claimed method step wherein the proportions of the softened water and untreated water are varied to increase the top operating temperature of the operating system and increase the recovery of potable water.

As such, the Examiner has not established a *prima facie* case of obviousness. Accordingly, withdrawal of the §103 rejection based on Al-Samadi is requested.

VI. Claim Rejections – 35 U.S.C. §103

Claims 1-18 and 24-29 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over WO 99/16714 ("Hassan") in view of Gelblum.

Hassan is directed to a hybrid process for the desalination of sea water. This hybrid process consists of combining nanofiltration technology with basic desalination processes. In

accordance with Hassan, sea water is passed through a membrane nanofiltration unit to form a first water product having a reduced content of ionic species, microorganisms and particulate matter. Thereafter, 100% of the softened water product is used as the make-up or feed to a desalination system. There is no disclosure or suggestion by Hassan that a blend or variable percentage of make-up would advantageously improve the performance of desalination plants.

As discussed in Section IV, above, Gelblum is directed to a process for softening sea water by the $Ba(HCO_3)_2 \cdot CaSO_4$ reaction mechanism to form a joint precipitate of $BaSO_4$ and $CaCO_3$ (See claim 1). There is no disclosure or suggestion of achieving this object with the use of ion selective membranes. Figure 2 illustrates a modification of the Gelblum process whereby a stream of sea water is split into two streams: a first stream softened in reactor 1 by the $Ba(HCO_3)_2 \cdot CaSO_4$ reaction mechanism and a second stream which is not softened. The two streams are mixed to form a feed which is sent to the distillation system 3. Gelblum states that the decalcification of sea water by the Ba(HCO3)2.CaSO4 reaction mechanism to the extent of 60-70% reduces the size of the plant and operating costs.

The Examiner alleges that it would have been obvious at the time the claimed invention was made to modify the process of Hassan to softened only a portion of the seawater feed as disclosed by Gelblum. Applicant respectfully disagrees for the following reasons.

Firstly, Hassan and Gelblum represent technologically diverse and unrelated processes. Hassan uses ion selective membranes to pretreat seawater whereas Gelblum employs chemical additives to pretreat water and bring about the precipitation of certain ionic species.

Secondly, Hassan is aimed at the ***prevention of precipitation*** of scale and other foulants. Moreover, an express purpose of Hassan is to provide a water desalination process with ***lower chemical consumption***. These objectives are achieved by pretreating water with ion selective

membranes (page 11, lines 18-24). It is submitted, therefore, that Hassan is antithetical to Gelblum which relies on the recovery of chemically-precipitated compounds. Therefore, the respective intent, purpose and function of Hassan and Gelblum are incompatible. As such, the person of ordinary skill in the art who is interested in water-softening processes by the use of ion selective membranes would not be motivated to consider the chemical precipitation as disclosed by Gelblum.

Thirdly, Gelblum does not provide a working example of the embodiment represented by Figure 2. Thus, Gelblum is nonenabling with respect to that embodiment. Moreover, Gelblum does not suggest the use of ion membranes. Therefore, the prior art does not provide the requisite motivation to modify the process of Hassan to operate with membranes having 60%-70% efficiency. In any event, to achieve removal of 60% of the calcium with a membrane having 60% efficiency, Applicant submits that 100% of the feed would have to be treated.

Therefore, for all of the foregoing reasons, Hassan and Gelblum are not properly combinable:

- The reduction of ionic content by chemical precipitation, as taught be Gelblum, is incompatible with the intent, purpose and function of the Hassan method which employs ion selective membranes to soften a stream of sea water.
- The person of ordinary skill in the art who is interested in water-softening processes by the use of ion selective membranes would not be motivated to consider Gelblum which discloses water-softening chemical precipitation.
- Neither Hassan nor Gelblum suggest the use of ion selective membranes having 60-70% efficiency. Nevertheless, to achieve removal of 60% of the calcium with a membrane having 60% efficiency, Applicant submits that 100% of the feed would have to be

treated. Therefore, the combination of Hassan and Gelblum do not suggest the claimed invention wherein only a percentage of the feed is presoftened and blended with the untreated water to produce a variable feed.

It is respectfully submitted, therefore, that the rejection in view of the combination of Hassan and Gelblum is based on an impermissible hindsight reconstruction of the invention. As such, the Examiner has not established a *prima facie* case of obviousness. Withdrawal of the §103 rejection based on the combination of Hassan and Gelblum is requested.

VII. Claim Rejections – 35 U.S.C. §103

Claims 24 and 26 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over US 5,238,574 to Kawashima et al. ("Kawashima").

The rejection is moot in view of the cancellation of claims 24 and 26. Accordingly, withdrawal of the §103 rejection based on Kawashima is requested.

Mark-up showing amendments t claim 28:

28. (Amended) The desalination process of claim 1 [or 24], wherein the first stream of water is selected from the group consisting of salt water, seawater, brackish water and impaired water.

CONCLUSION

Upon entry of this Amendment, claims 1-18 and 27-29 are pending. Applicants respectfully submit that claims 1-18 and 27-29 are directed to patentable subject matter. Accordingly, Applicants request allowance of the claims.

Authorization is hereby given to charge any fee in connection with this communication to Deposit Account No. 23-1703.

Dated: 5 December 2002

Respectfully submitted,

John M. Genova
Reg. No. 32,224
Attorney for Applicants

Customer No. 07470
Attorney's Direct Line: (212) 819-8832